Outline

1 – Monopolistic competition
2 – Game Theory and Strategic Interaction

MONOPOLISTIC COMPETITION

Our goal now is to begin to investigate the middle ground between perfect competition and monopoly.

In such markets, things are more complicated and it is less easy to make general statements as we can for the two extreme cases – much depends on the details of the industry. For that reason we will look at various different models that will be appropriate under different circumstances.

One industry structure which captures a flavor of both is MONOPOLISTIC COMPETITION. These are industries in which although firms compete, they sell DIFFERENTIATED PRODUCTS so that the competition is not directly head-to-head. Firms have some scope to raise prices without losing all their customers as their products have some unique selling point that appeals to particular consumers.

Examples – the newspaper market that we discussed in Lecture.

We can analyze the pricing decision of each firm as if they are a monopolist since they have some pricing power.
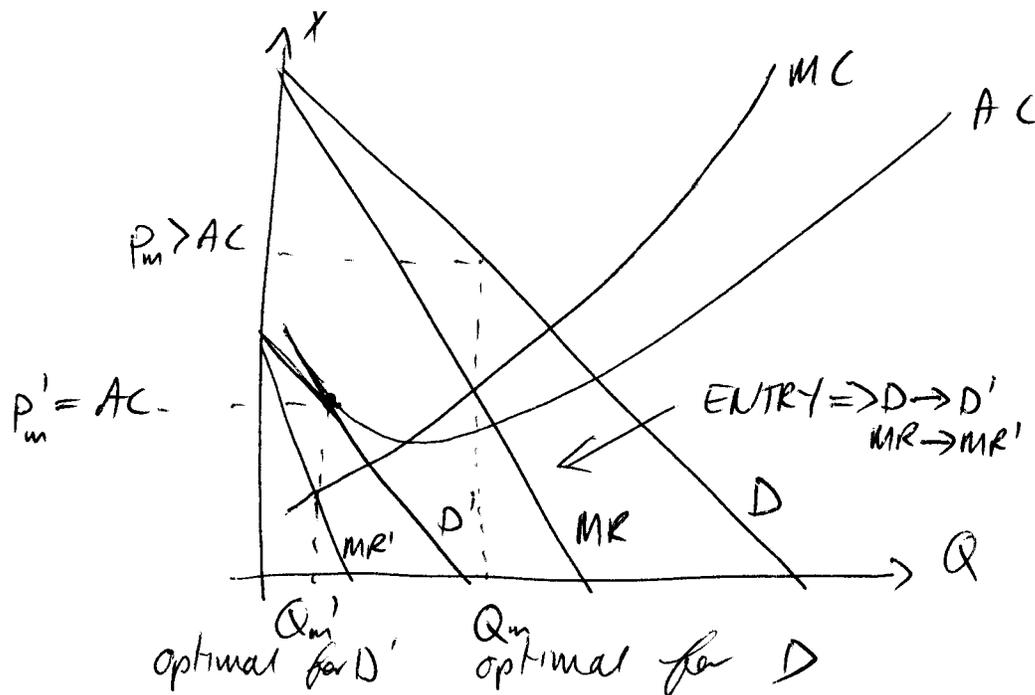
o) $MC = AC$ at min AC

i) Q_m is where
   $MC = MR$

ii) Q_m' is where
   $MC = MR'$

iii) P_m is on D
   at $Q = Q_m$

iv) P_m' is on D'
   at $Q = Q_m'$

v) $P_m > AC \Rightarrow$ profits

vi) $P_m' = AC \Rightarrow$ no profit

vii) $P_m, P_m' > MC \Rightarrow$
   inefficient

ENTRY $\Rightarrow D \rightarrow D'$
$MR \rightarrow MR'$

$P_m > AC$

$P_m' = AC$

Q_m' optimal for D'

Q_m optimal for D

What is the competitive aspect? It is that there is nothing to stop other firms entering with their own varieties. How can we model this? As the market becomes more crowded the demand which can be capture by each individual firm shrinks. It will keep shrinking until profits are zero.

This is similar to the story we told about a perfectly competitive industry, but note that here things are more complicated. In particular, the long run equilibrium is NOT EFFICIENT – FIRMS HAVE EXCESS CAPACITY in the sense that AVERAGE COSTS ARE NOT MINIMIZED EVEN IN THE LONG RUN.

The key to this result is that even though firms have pricing power, so can raise prices above marginal costs, they also have fixed costs. The monopoly profits are offset by the fixed costs, and as entry occurs profits are bid down until they are completely absorbed by the fixed cost – but even so the price distortion at the margin keeps quantity below that at which AC is minimized.

$$\rightarrow \text{ In SR } \quad p > mc \quad p > AC \quad . \quad \text{In LR } \quad p = AC \quad , \quad p > mc$$

GAME THEORY

$$\Rightarrow \quad AC > MC$$
$$\Rightarrow \quad AC > mi \quad (AC)$$

In general when we think about firms with a small number of firms we use the tools of GAME THEORY. We analyze the STRATEGIC INTERACTIONS AMONG THE FIRMS.

A "game" has a specific meaning in economics. In particular we define a game as:

     i)   rules
     ii)   strategies
     iii)   payoffs
     iv)   outcome

The idea is that all players know the structure of the environment they are acting in – the "rules". In particular, they know what the relevant decision variables for themselves and the other players are – the strategies – and they know what the consequences of these decisions are both for themselves and the other player – the payoffs.

The goal in game theory is to analyze the economic environment above and make a prediction about the outcome – i.e WHAT IS THE EQUILIBRIUM.

In analyzing games we will use a lot 2 tools;

     i)   the payoff matrix
     ii)   Nash equilibrium

The payoff matrix summarizes all the information relevant to points I)-iii) above – it is a complete description of the economic environment – who can do what, and what the consequences are.

Nash equilibrium is the basic tool we use to predict the outcome. Let's look at an example of a payoff matrix and then understand how to use the idea of Nash Equilibrium.

A famous game in economics is the PRISONER'S DILEMMA. It's important as it captures the basic conflict between competition and cooperation in industries with a small number of firms.

We'll use this game to illustrate the concepts above – mapping the environment into rules/strategies/payoffs and showing how to solve using NASH EQUILIBRIUM

Set up of the PD is a parable. Two prisoners have been caught and are being interrogated about a crime. They are in separate rooms and don't know what their accomplice is saying. Each prisoner can separately choose whether or not to confess. If neither confesses they get convicted of a lesser crime for 3 years. If one confesses and the other not the confessor gets a light sentence of 1 year and the other gets 10. If they both confess they get 5 years.

The first thing to do is set up the payoff matrix

		BONNIE	
		Confess	Deny
CLYDE	Confess	**5,5**	1,10
	Deny	10,1	3,3

In this example there are 2 strategies for each player – they just have to decide whether to confess or deny.

The payoffs here are simply the years in jail.

Each cell of the matrix describes the payoff for (Clyde, Bonnie) as a function of the strategy chosen by each of them. NOTE – there is interdependence – the other player's choice affects me – this is the essence of a game.

What is the NASH EQUILIBRIUM OF THIS GAME?

DEFINITION

THE NASH EQUILIBRUIM IS A STRATEGY CHOICE FOR EACH PLAYER SUCH THAT EACH CHOOSES OPTIMALLY TAKING AS GIVEN THE CHOICE OF THE OTHER PLAYER.

Compare with competitive equilibrium – there players took the market price as given and formed responses. Here we think of players taking the strategic choice of the other player as given and forming a best response. Just as in competitive eqm, the outcome was the price that made firms and consumers choices consistent with each other, here NE is the outcome which makes each player's assumptions about what other players are doing and the actions they choose consistent with each other.

To find the NE, players don't necessarily know what the other player will do – they form a conjecture and they choose the best response to every possible choice of the other player. In equilibrium the conjecture they make must be right – this is because the other player is also making the same calculations and the equilibrium is the pair of choices that make each players assumptions correct This is similar to the demand and supply curves – firms don't know what the price will be, but they think through a supply schedule for every possible price. The equilibrium then selects the actual price and firms choices are then consistent with the price that occurs in equilibrium.

In this example, consider what happens from Clyde's perspective:

i)   if Bonnie confesses Clyde gets 10 if he denies and 5 if he confesses – he chooses confess

ii)   If Bonnie denies Clyde gets 3 if he denies, 1 if he confesses – he again confesses.

Likewise for Bonnie.

Thus (Confess, Confess) is a NE since it is optimal given the choice of the other. There is no other NE – if Bonnie expects deny, she confesses. If Clyde expects Bonnie to confess, he would also confess, so Bonnie would not expect Clyde to deny and this can't be part of an eqm.

Thus we have found the outcome of the game – if both players are rational and understand the structure of the game we would expect both of them to confess.

The interesting aspect of this game is that (Deny,Deny) is better for both of them, so the outcome is inefficient. But if both choose simultaneously they can't get to this outcome.

The parallel with the competitive process is as follows:

In many industries the profit maximizing thing to do would be for firms to agree not to engage in price competition. Then the industry as a whole would be like a monopoly and all can share in the profits. The problem with this outcome is that it corresponds to the deny/deny outcome above – it is not sustainable as an equilibrium.

If everyone else is keeping their prices high, any individual firm has an incentive to cut its prices a little bit and capture sales at the expense of the other firms. Since they all understand this the only outcome will be a price war. Since price fixing is mostly illegal

the only way this could work would be a gentleman's agreement – there can be no contract. But with nothing binding the players, everyone knows about the price-cutting threat and would rush to be the first to do so.

Repeated Games

How can we get around this outcome – we need to change the nature of the game. For example if we think the game is REPEATED then the incentives to cheat are lower as the other firms can threaten to retaliate, thus firms have a chance to build reputations for being cooperative players.

Another way of extending the basic analysis of games is to allow repetition – for example to assume that the same firms interact with each other over and over again.

If we think of the PD as a Cournot game.

Either both firms can choose low output levels, and both profit 10 each.

		Firm 1	
		Low Q	High Q
Firm 2	Low Q	10,10	6,12
	High Q	6,12	8,8

Note that we are assuming that both
   i)   total profitability falls with total output
   ii)   if one chooses low, one high then those profits go disproportionately to the High Q firm (they have more of the market)

The NE of this game is (Hi,Hi) even though (Lo,Lo) is better for both. Thus the dilemma for these firms is how to sustain cooperation even though both know that the other firm will try to cheat it.

The key is to change the rules of the game so that these incentives are changed. One way to think about this is as a repeated game.

For example we can consider a TIT-FOR-TAT strategy.

Each firm will give the other the benefit of the doubt and play low, but if the other firm ever cheats them, they will retaliate with high in all future periods. In this environment firms want to maintain their REPUTATION for cooperative behavior as it keeps profits high. The cost of losing reputation offsets the incentive to cheat.

Under tit-for-tat strategy (lo,lo) in every period can be an equilibrium outcome:

Consider the incentives for one firm to deviate. As always in NE we hold the STRATEGY OF THE OTHER FIRM constant and choose our strategy.

The other firm is playing tit-for-tat and we have not deviated yet so up to this period we have cooperated and so the other firm plays lo.

If I deviate this period I must be choosing high, as otherwise I am just following my strategy which says play lo.

Since other firm plays tit-for-tat I know that in the future firm will always play high, so in future periods I will be playing high as well.

Thus from my point of view we have the following profit streams:

Period	0	1	2	...all future
Don't deviate	10	10	10	10
Deviate	12	8	8	8
Net gain to deviation	+2	-2	-2	-2

Thus provided firm takes into account what happens beyond the next period, the deviation is not likely to be beneficial.

Thus given that the other firm plays tit-for-tat I find it optimal to play tit-for-tat as well and the equilibrium outcome is the cooperative (lo,lo) in every period.

Sequential Games

An important assumption in the prisoner's dilemma is that players act SIMULTANEOUSLY. There is no opportunity for one player to respond to the choice of the other. Sequential games introduce some new issues.

Consider the following scenario:

Two firms, one incumbent and one potential entrant. Currently the incumbent is making economic profit of 10. The incumbent needs to make an investment costing 2 to get into the industry. However, whether this is profitable depends on what the incumbent does – either they'll engage in a price war and profits will be driven to 0, or the incumbent will accommodate the entrant and they'll share the profits getting 5 each.

We can represent this situation in a game matrix:

		Incumbent	
		Fight	Accommodate
Entrant	In	-2,0	3,5
	Out	0,10	0,10

What are the Nash Equilibria of this game?

There are 2:

(in, accommodate) and (out,fight)

Thinking about (in,accommodate):

If entrant comes in then incumbent chooses between 0 and 5 and so will accommodate.

If incumbent accommodates then entrant chooses to in (**3**) and out (0) so will enter.

This is therefore a NE

What about (out, fight)

If entrant stays out then incumbent can make any claim about what he would do in the case of entry – it is never tested and the payoff is the same 10 – thus in particular he could claim he would fight.

If the incumbent is going to fight then the entrant chooses between (-2) in and (0) out and so would stay out.

Thus this outcome satisfies the definition of a NE. What is wrong with it?

The equilibrium arises because of a threat which the entrant takes seriously. Incumbent adopts a strong posture and claims he will fight. If this threat is taken seriously then the entrant indeed stays out.

Question is SHOULD THE ENTRANT TAKE THE THREAT TO FIGHT SERIOUSLY?

Useful to lay out the information in a GAME TREE
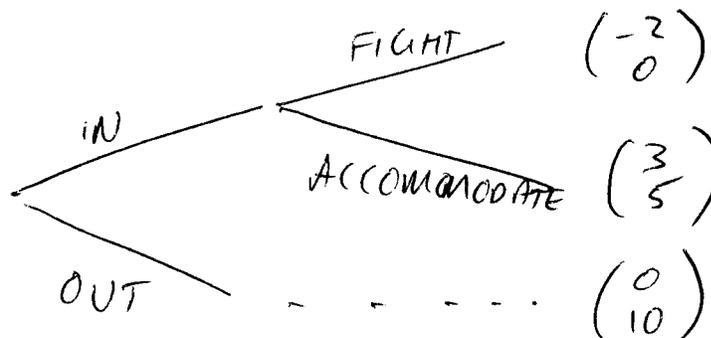
The key here is that there are really 2 games here – the full game, and the final stage. Once the entrant makes his decision we can think about the stage when the incumbent decides what to do as a game in itself.

Now we can see that the threat to fight is NOT CREDIBLE. i.e. IF WE EVER GET TO THE POINT WHERE THE ENTRANT ENTERS, THE OPTIMAL CHOICE IS TO ACCOMMODATE.

If the entrant realizes this the threat to fight would never be taken seriously.   The equilibrium where the entrant stays out rests on the fact that the threat is never tested, so the entrant takes it seriously.

We rule out these type of equilibria by assuming that NEITHER PLAYER CAN MAKE NON-CREDIBLE THREATS, THAT THEY WOULD NOT CARRY OUT IF THEY WERE TESTED.

The way to find the equilibrium of the game is then work from the end – BACKWARDS INDUCTION. The entrant knows that the only possible outcome in the 2nd stage – IF HE ENTERS - is accommodate. Thus his choice is only between (enter+accommodate) and (out)

Reducing the game tree we see that the entrant will enter.
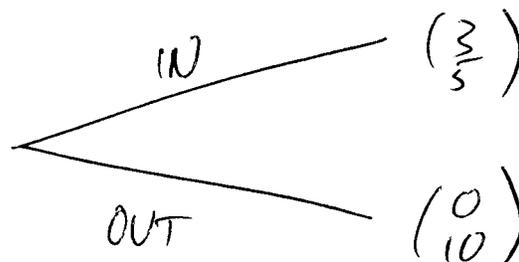
What have we found? SOMETIMES GAMES HAVE SEVERAL EQUILIBRIA WHICH SATISFY THE NASH CRITERION. We rule out some of these equilibria by refining the concept so that ONLY CREDIBLE THREATS CAN BE MADE.

We call this refined concept SUBGAME PERFECT NASH EQUILIBRIUM (SPNE)- We only predict equilibria which rely on strategies that would actually be played if their subgames (part of the game tree) are reached.

We apply the SPNE by solving backwards from the end of the tree, treating each stage as a game in itself, and only allowing those strategies that are also equilibria of these subgames to count in the full equilibrium.